

SOME NEMATODES FROM AUSTRALIAN FROGS

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Oswaldocruzia limnodynastes n. sp.

(Fig. 1-4)

From intestine, *Limnodynastes dorsalis*, Adelaide.⁽¹⁾ Female, 6.7 to 9.5 mm. long; breadth .12 mm. for worms 6.7 to 7 mm. long, .15 mm. for worms 9.5 mm. long. Male, 3.8 mm. long, .1 mm. broad. Body filiform, tapering at both ends in female, but tail truncate in male; tail of female ending in spine 18 μ long. Cuticle with about 24 longitudinal striations (as in *O. malayana*) visible under oil immersion together with much finer longitudinal markings between the larger. Lateral membranous wings absent; cephalic cuticle inflated, with fine transverse striations, inflated region broader anteriorly but tapering posteriorly to end at .1 mm. from the head end of a worm 6.7 mm. long. Transverse striations not observed caudad of inflated area. Four minute submedian head-papillae; cervical papillae absent.

Mouth with three insignificant lips devoid of papillae or special chitination. Oesophagus .43 mm. long, 18 μ broad in region of nerve ring in female 6.7 mm. long; cylindrical anteriorly, posterior portion conical. Intestine dilated just in front of conical rectum. Rectal glands, probably three, at sides of narrow junction of intestine and rectum. Anus .2 mm. from tip of tail in female 8.4 mm. long.

Nerve ring inconspicuous, .18 mm. from anterior end of worm 6.7 mm. long, in vicinity of excretory aperture. Latter on very slight elevation, .27 mm. from head end of female 6.7 mm. long. Excretory sac 90 μ long, 45 μ broad, opening about 25 μ from its anterior end into small tube leading to pore. The Y-shaped gland of *O. insulae* Morishita (1926) and the corresponding organ (Travassos 1917) in *O. leidy* appear to be much more ornate than the simple sac of *O. limnodynastes*.

Female—Ovaries arising anterior to genital pore; divergent, one extending anteriorly almost to pharynx and then returning as oviduct, posterior ovary travelling caudad to region of rectum to become the oviduct which bends forwards as uterus. Vulva a transverse slit, 40 μ long, in anterior part of posterior third of body, with slightly protruding lips. Vagina thin-walled, divergent, each arm 40 μ long and continuous with short ovejector. Latter of two portions, proximal part puckered and corresponding to the funnel of *O. leidy* as described by Steiner (1924), distal part with faint longitudinal striations suggesting muscle fibres; distal portion leading through four valves with longitudinal striations into vagina. Valvular region with small lumen and very thick walls, area just behind valves slightly bulbous and with faint transverse striations suggestive of sphincter fibres; on outer side of bulb a row of large cells with distinct nuclei, these cells being probably secretory and representing the "varnish gland" of *O. leidy* (Steiner 1924) and *O. pipiens* (Walton 1929). A vulvar dilator muscle was seen in the same position and with the same relations as that of *O. leidy*. Eggs 36 μ by 25 μ , in morula stage on arrival in uteri. Oviduct walls more granular at junction with uterus, this part perhaps serving as a shell gland.

Male—Testis enlarged posteriorly before entering vesicula seminalis; ejaculatory duct and rectum forming partly chitinated tube opening at base of genital cone. Spicules short, 95 μ in length, shape difficult to determine because of

⁽¹⁾ *O. limnodynastes* has also been identified from material collected from *Hyla aurea* from Sydney and Melbourne.

presence of spines and projections; distal portion apparently ending in three spines, one strongly chitinized and forming base of somewhat trowel-shaped spicule, the other two spines supporting its sides; proximal part characteristic, forming short handle of the trowel and provided with median spine. Accessory piece slightly curved, slipper-shaped, $45\ \mu$ long. Gubernaculum absent.

Bursa with two lateral and a small median dorsal lobe. Latter supported by dorsal ray ending in four branches, the arrangement resembling that of *O. pipiens* (Walton 1929). Each lateral lobe with six rays; ventro-ventral and latero-ventral close together and reaching edge of bursa; externo-lateral slightly broader than the others and curved ventrally; median and postero-lateral rays together and reaching edge of bursa; externo-dorsal arising from base of dorsal ray. Three pairs minute preanal papillae. Genital cone chitinized, $12\ \mu$ long.

Our specimens fall within the genus *Oswaldocruzia* Trav. 1917, as amended by Morishita (1926), because of the filiform body, expanded head, transversely striated cuticle, form of bursa, ventral rays nearly equal and adjacent, medio- and postero-lateral rays parallel and curving dorsad, externo-dorsal ray arising from the base of the thick, straight dorsal ray which divides into four branches at its extremity, spicules equal similar and branched and absence of gubernaculum and prebursal papillae. The presence of an accessory piece is not usually mentioned by authors, though Baylis (1933) stated that in *O. malayana* it was narrow and canoe-shaped but was not heavily chitinized. Travassos (1937) transferred the latter species to *Trichoskrjabinia*. The latter author reviewed the genus *Oswaldocruzia* (1937) in his monograph of the Trichostrongylidae.

***Spironoura hylae* n. sp.**

(Fig. 5-7)

From intestine, *Hyla aurea*, Sydney. Slender elongate worms; female 12-18 mm. long by $\cdot 45$ mm.; male 13-13.5 mm. by $\cdot 33$ - $\cdot 38$ mm. Mouth with three lips, each with two papillae; pulp of each papilla expanding just below surface as though to subtend two, instead of one, papillae, the condition thus being intermediate between that of *Spironoura* which has two inner and two outer papillae on each lip, and that of *Zanclophorus* which possesses two papillae on each lip.

Buccal cavity with three chitinous plaques similar to those described by Seurat (1918) for *S. lambdiensis*; two horse-shoe-shaped cuticular supports at each corner of cavity. Short anterior gullet or pharynx; oesophagus long, 1.84-2.1 mm. in male; oesophageal bulb differentiated into anterior somewhat pyriform portion and posterior spherical region, separated by deep constriction. Several valves at oesophageo-intestinal aperture. Intestine slightly dilated at anterior end; rectum narrow with chitinized walls and receiving rectal glands; large anal dilator muscle. Simple sac-like excretory vesicle with narrow duct opening on mid-ventral surface, $\cdot 67$ mm. from anterior end in male specimen 13 mm. long. Nerve ring $\cdot 4$ - $\cdot 43$ mm. from anterior end in female, $\cdot 37$ mm. in male.

Female—Vulva near commencement of posterior third of body length; lips protruding slightly. Vagina lined by large columnar cells; sphincter near vulva; vagina passing forwards, widening somewhat just before junction with the two uteri. Latter lined by flattened cells; opposed, each uterus bent on itself in a number of U-shaped loops in anterior and posterior parts of body; circular muscle at junction of uterus and oviduct. Each ovary forming long loop in anterior region of body, anterior ovary and uterus remaining there, the other ovary proceeding a short distance caudad from vulva to join oviduct, the posterior uterus making its way forwards to enter the vagina anteriorly to the vulva. Both oviducts U-shaped. Eggs 54 by $43\ \mu$, little development before being laid.

Male—Testis arising in posterior half of body, extending forwards nearly to oesophagus before bending back to become vas deferens. Preanal sucker just in front of oblique muscles of tail. Spicules 2 mm. long, curved, similar, flattened laterally, much broader at distal end, ventral side with two thickened ridges that are more heavily chitinized at the free end of the spicule. Accessory piece shaped like an open trough with the four corners prolonged into spines. Papillae ten pairs including four preanal pairs; single median pre-anal papilla.

The species agrees with *Spironoura* in having a pharynx and oblique muscle; in the characteristic preanal sucker; and in the absence of cuticular fringes on the lips. It differs from *Spironoura* but agrees with *Zanclophorus* in the number of papillae on each lip, the presence of horse-shoe-shaped cuticular ridges at the corners of the mouth, the presence of cuticular plaques in the vestibule, the length of the spicules, and the presence of a fairly well developed accessory piece. These facts suggest that *Zanclophorus* should be regarded as a synonym of *Spironoura* whose generic diagnosis would then require some emendation.

***Cosmocera limnodynastes* n. sp.**

(Fig. 13-15)

Small worms from intestine of *Limnodynastes dorsalis*, Adelaide. Female 4.25 mm. long, 485 μ broad; male 1.6 mm. long, 185 μ broad. Mouth with three insignificant lips, dorsal less prominent than ventro-laterals; each lip with two small papillae. Ventral wall of pharynx prolonged between ventro-lateral lips to resemble a fourth lip.

Mouth opening into small vestibule about 15 μ long. Oesophagus simple, straight, dilated posteriorly to form bulb with valvular apparatus in centre. Oesophagus and bulb 430 μ long in female; 310 μ long and 27 μ broad in male; bulb 53 μ long and 59 μ broad in male; its opening into the anterior swollen part of intestine guarded by valves. Rectum lined with chitin; three large rectal glands present.

Nerve ring 8.75 μ broad, 149 μ and 162 μ from anterior end in male and female respectively. Excretory pore on same level as oesophageal bulb; 431 μ from anterior end in female, 306 μ in male. Two longitudinal excretory canals joining ventrally to form terminal vesicle opening on slight prominence on mid-ventral surface; terminal region of canals and the vesicle itself surrounded by group of large cells. Excretory pore with circular and longitudinal muscle fibres.

Female—Ovaries arising in anterior part of body and passing forwards to about 300 μ from anterior end, then turning back to travel posteriorly. One enters its uterus in region of vulva; the other forming with the posterior uterus a U-shaped loop near the rectum. Uteri large, with eggs in all stages of development; coiled embryo present in the more mature eggs. Vagina 250 μ long; 2.1 mm. from anterior end of a worm 3.8 mm. long. Eggs 144 μ long, 94 μ broad. In their general outlines the genitalia of the female resemble those of *C. commutata* (Travassos 1931).

Male—Tail curved ventrally, ending in short spine; numerous papillae and plectanes. Latter in two rows of five each, preanal in position; also a single median plectane just anterior to cloacal opening; each plectane strengthened by chitinous tooth and bearing rosette consisting of ring of small teeth at its extremity. Row of papillae on each side of plectanes; five pairs of papillae near spicule, two of these surrounding anus. Post-anal papillae arranged in two series, one series on either side of mid-ventral line; and the other irregularly scattered over the surface; size of papillae decreasing as they proceed caudad. Gubernaculum large, 0.11 mm. long, shaped like a spicule with a grooved ventral surface in which spicules glide. In both the specimens examined it protruded from the surface of the body and its free end was pointed. Walls of cloaca chitinized and

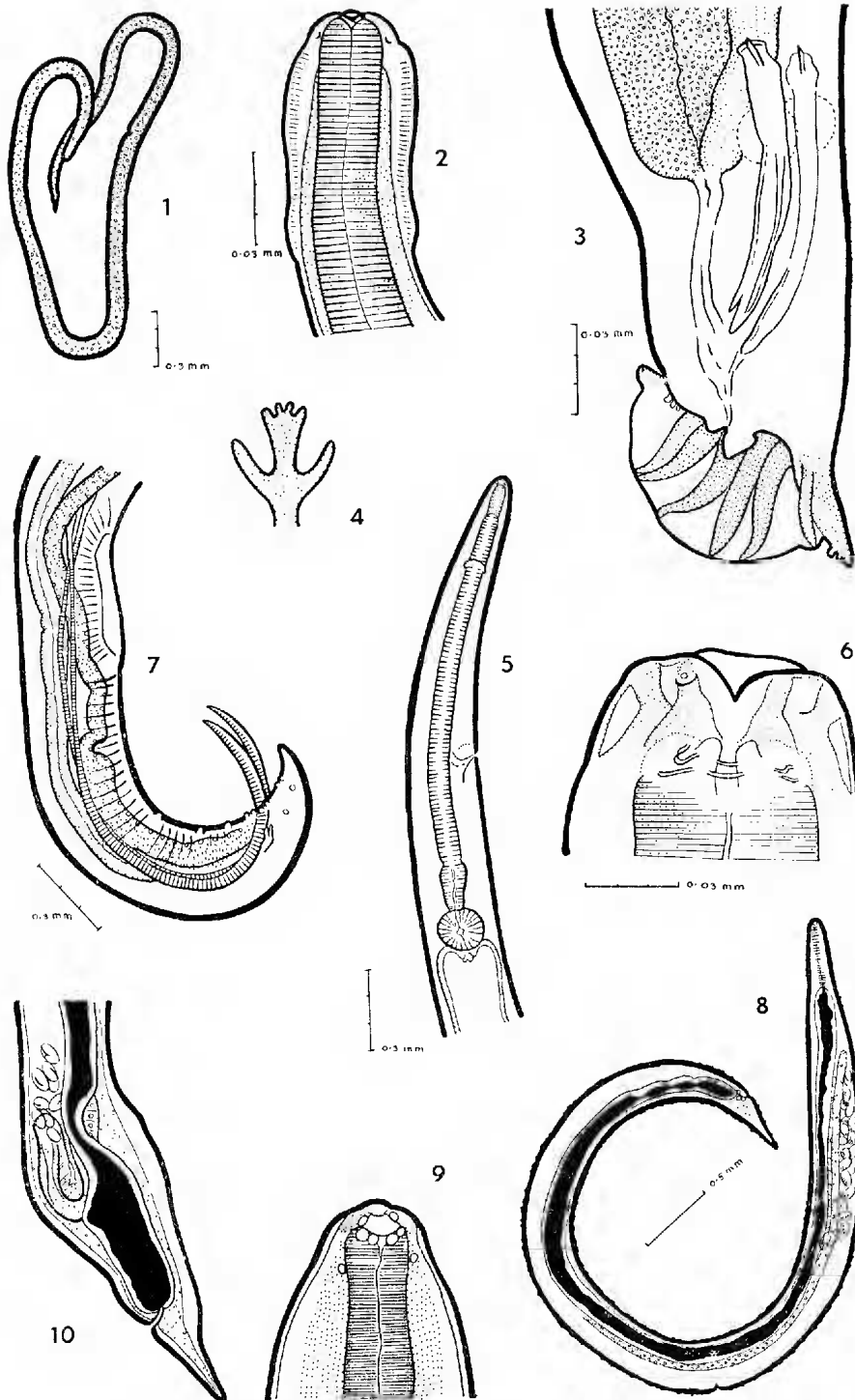


Fig. 1-10

Fig. 1-4, *Oswaldocruzia limnodynastes*: 1, female; 2, head (to same scale as fig. 3); 3, tail of male; 4, dorsal ray. Fig. 5-7, *Spironoura hylae*: 5, anterior end; 6, head; 7, tail of male. Fig. 8-10, *Rhabdias hylae*: 8, worm from lung; 9, head; 10, tail.

especially thickened just below anus, to constitute an accessory piece. Spicules slender, resembling simple curved rods; $2.4\ \mu$ broad; length not ascertained with certainty but lying somewhere between $50\ \mu$ and $75\ \mu$. In general configuration, gubernaculum and spicules resembling those of *C. commutata* as figured by Travassos (1931).

***Cosmocerca australiensis* n. sp.**

(Fig. 16)

Females from intestine of *Limnodynastes dorsalis*, from the vicinity of Adelaide. Since no males are available, classification is difficult, the distinctions between sub-families being based upon characters possessed by the male. The specimens belong to the Cosmocercinae (Railliet 1916) and most closely resemble members of the genus *Cosmocerca*. They differ from the allied *Cosmocercella* in the extreme anterior position of the vulva and in the absence of typical papillae, only two labial papillae being present in this species; and from *Aplectana* in the anterior position of the vulva and in the absence of two divisions in the oesophagus. They are accordingly grouped provisionally under *Cosmocerca*.

Worms short, $7.5 - 9$ mm. long, $380 - 480\ \mu$ broad. Cuticle transversely striated. Tail ending in long spine about 1.0 mm. in length. Oesophagus (including bulb) $353\ \mu$ long, $47\ \mu$ broad; slightly dilated just anterior to, and constricted just before entering, bulb; latter $99\ \mu$ long, $126\ \mu$ broad, with valvular apparatus in centre; its opening into intestine guarded by valves. Intestine simple, anterior part slightly swollen. A number of rectal glands; well-developed post-anal dilator muscle.

Terminal excretory vesicle circular, supported by chitinous thickenings; opening immediately anterior to vulva. Nerve ring $150\ \mu$ from the anterior end.

Ovaries divergent, arising near mid-body; posterior ovary proceeding caudad, to give rise to oviduct; anterior ovary passing forwards into vicinity of vagina to become convoluted, its oviduct proceeding caudad to region of rectum, whence, turning back again, it runs alongside the other oviduct. The two travel cephalad and open into the large uterus, which contains eggs in the morula stage. Vagina divided into proximal glandular and distal muscular portion; vulva at $573\ \mu$ from anterior end. Eggs ellipsoidal, $137\ \mu$ by $36\ \mu$.

***Cosmocerca propinqua* n. sp.**

(Fig. 11-12)

Females from intestine of *Limnodynastes dorsalis*, Adelaide. It is closely allied to *C. australiensis*, and differs from it in the following characters:

Worms shorter, measuring 5 mm. long, $369\ \mu$ broad; oesophagus $480\ \mu$ long, $43\ \mu$ broad, its bulb $108\ \mu$ long, $126\ \mu$ broad; nerve ring $126\ \mu$ from anterior end. Excretory vesicle oblong; chitinous rim surrounding the excretory pore.

Ovaries arising near mid-body and passing posteriorly where they enter the oviducts; latter proceeding cephalad, becoming convoluted and then, passing caudad, opening into uterus posteriorly. Uterus extending from region of ovaries to beginning of tail; anteriorly passing into thick-walled vagina. Vulva forming marked projection on ventral surface of body, $290\ \mu$ from anterior end, well in front of oesophageal bulb, and in this feature especially differing markedly from *C. australiensis*.

***Rhabdias hylae* n. sp.**

(Fig. 8-10)

From lung, *Hyla aurea* from Sydney (type host and locality) and from Melbourne; *H. caerulea* from Brisbane; and *Limnodynastes tasmaniensis* from Adelaide. The following account is based on material from *H. aurea* from Sydney.

Length $6.5-7.8$ mm.; breadth $.34-.37$ mm. Cuticle with faint longitudinal

striations and with annular ridges at regular intervals. Excretory pore probably immediately behind nerve ring. Mouth terminal with six very low, scarcely discernible lips. Buccal capsule 11μ long. Oesophagus $.38-.46$ mm. long, maximum breadth $36-46\mu$ (near nerve ring), muscular, slightly swollen just in front of nerve ring, club-shaped toward posterior end. At junction of buccal

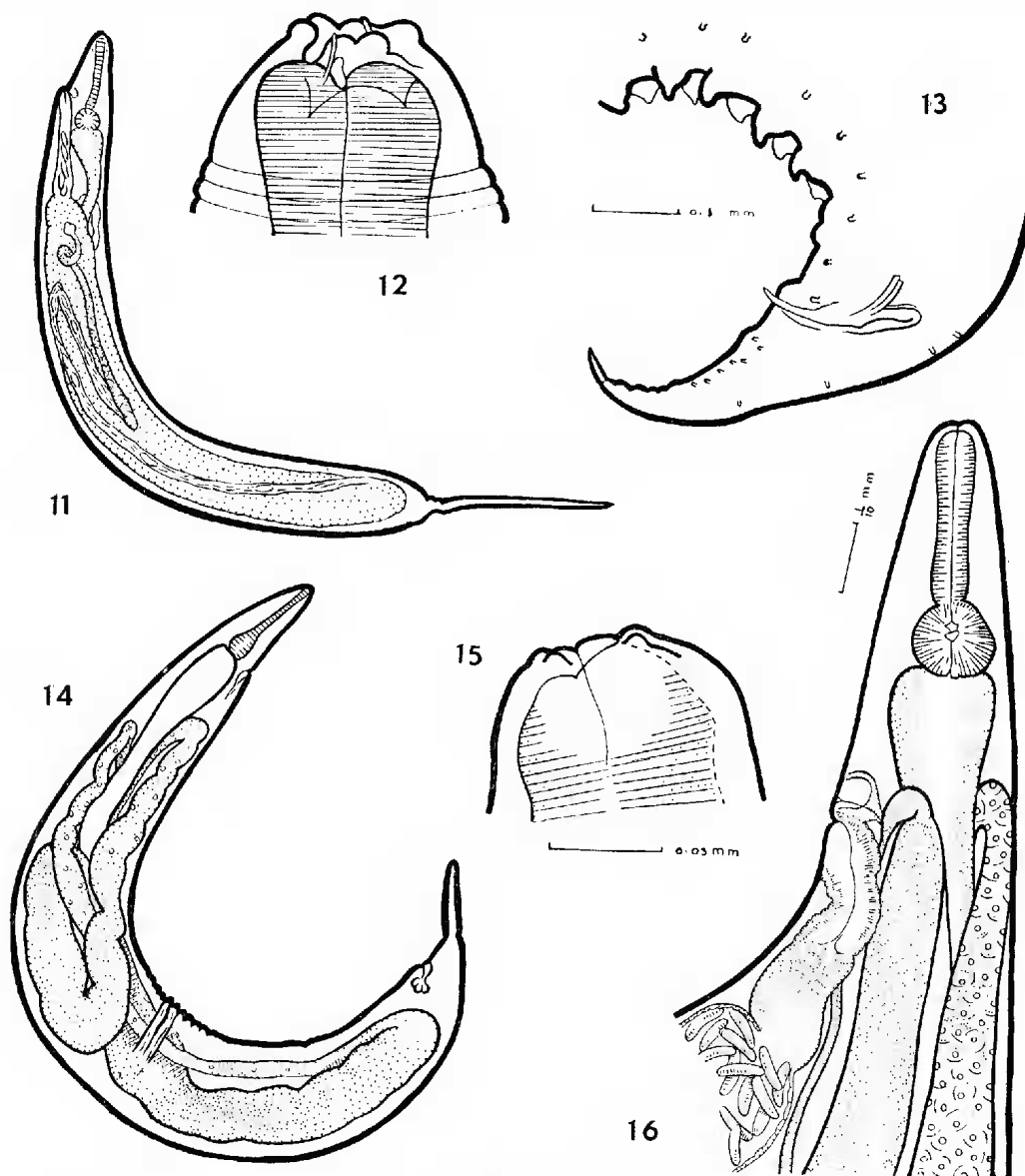


Fig. 11-16

Fig. 11-12, *Cosmocerca propinqua*. Fig. 13-15, *Cosmocerca limnodynastes*. Fig. 16, *Cosmocerca australiensis*.

capsule and oesophagus eight tooth-like structures seen in some specimens. Intestine dark brown; constricted near its posterior end, then swollen, then constricted suddenly into narrow rectum with well-chitinated wall. Anus at $.34-.4$ mm. from posterior end. Nerve ring at $.17-.18$ mm. from anterior end; a more anterior ring at about 36μ from head end.

Vulva at 3.25-3.85 mm. from anterior end, *i.e.*, almost at mid-length of body, immediately in front of it in measured specimens. Ovaries long, divergent, extending for greater part of length of body; bending back on themselves to lead into V-shaped receptaculum with thickened walls and then into widened uterus. The two uteri unite close to vulva. Eggs elliptical, 10 by 55 μ , with broadly rounded ends; with advanced embryos. Larvae common in lungs and digestive tract, especially rectum.

The occurrence of lung worms in Australian frogs has already been recorded. Haswell (1891) referred to the presence of *Rhabdonema* sp. in *Hyla aurea* in New South Wales. T. H. Johnston (1916) mentioned that *Rhabdonema* occurred in *Hyla caerulea* in Brisbane, and that *Rhabdias* sp. (1938, 151) was found in *H. aurea* in New South Wales and in Victoria. S. J. Johnston (1912) reported that lung worms occurred in the following species of frogs in New South Wales: *Hyla aurea*, *H. peroni*, *Limnodynastes peroni*, and *L. tasmaniensis*. Since we have recognised *Rhabdias hylae* from species of *Hyla* ranging from Brisbane to Melbourne as well as in *L. tasmaniensis* in Adelaide, it is very probable that the lung worms referred to by S. J. Johnston as occurring in frogs from the coastal region of New South Wales belong to *R. hylae*, and we have accordingly listed them under that name.

Chu (1936) gave a detailed account of his studies on the life history of *R. fuscovenosa* var. *catanensis*, a reptilian parasite in U.S.A., and indicated that eggs from the parasitic phase could undergo direct development or could give rise to a free-living sexual generation such as occurs in most species of *Rhabdias* from frogs so far investigated. He stated (1936, 140) that both types of life cycle were known to occur in *R. ranae*. One of us (T. H. J., 1931, 151) reported that the lung worm of *Hyla aurea* produced a free-living sexual generation. Travassos (1930) suggested the subdivision of *Rhabdias* and allocated the known species. Our form belongs to *Rhabdias* as restricted by him.

PHYSALOPTERA CONFUSA Johnston and Mawson

This nematode, in its adult stage, is common in the tiger snake, *Notechis scutatus*, in the Murray River districts of South Australia, where its presence was reported by Johnston and Mawson (1942, 90-91), who recorded finding the encysted larval stage in the viscera of the following frogs:—*Limnodynastes dorsalis* (including its variety *dumerili*) from the Adelaide district and from the Tailm Bend swamps, S. Aust.; *Hyla peroni* from the latter locality; and *Hyla aurea* from Sydney, New South Wales. We now record the finding of these larvae in their characteristic dark brown cysts in the submucosa of the stomach of *Limnodynastes tasmaniensis* and *L. dorsalis* from Sydney, and from *Hyla caerulea* from Brisbane. These records were not unexpected, since Johnston and Mawson (1942 a, 115) have recently reported the presence of the adult stage in the black snake, *Pseudechis porphyriacus* in the coastal region of New South Wales. Frogs form an important part of the food supply of this snake, as well as of the tiger snake.

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HOST LIST

- HYLA AUREA—*Rhabdias hylae* (Sydney; Melbourne); *Spironoura hylae* (Sydney); *Oswaldocruzia limnodynastes* (Sydney; Melbourne).
 HYLA PERONI—*Rhabdias hylae* (coastal region, New South Wales).
 HYLA CAERULEA—*Rhabdias hylae* (Brisbane); *Physaloptera confusa*, encysted larvae (Brisbane).

LIMNODYNASTES DORSALIS—*Rhabdias hylae* (New South Wales); *Oswaldo-cruzia limnodynastes* (Adelaide); *Cosmocerca limnodynastes* (Adelaide); *C. australiensis* (Adelaide); *C. propinqua* (Adelaide); *Physaloptera confusa* encysted larvae (Sydney).

LIMNODYNASTES PERONI—*Rhabdias hylae* (New South Wales).

LIMNODYNASTES TASMANIENSIS—*Rhabdias hylae* (Adelaide; New South Wales); *Physaloptera confusa*, encysted larvae (Sydney).

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